International Journal of Scientific Research and Management (IJSRM)
||Volume||13||Issue||03||Pages||600-610||2025||
Website: https://ijsrm.net ISSN (e): 2321-3418
DOI: 10.18535/ijsrm/v13i03.m02

Integrating Realistic Mathematics Education with Think Pair Share to Enhance Problem-Solving Ability and Mathematical Beliefs in Integer Learning

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Abstract:
Integer is a fundamental material in mathematics learning. In addition to mastering basic materials, problem-solving ability and mathematical beliefs are important factors in mathematics learning. An effective learning strategy is necessary to enhance mathematical belief and problem-solving ability. This study aims to analyze the effectiveness of integrating Realistic Mathematics Education with Think Pair Share to enhance problem-solving ability and mathematical beliefs in learning about integers. A Quasi-experimental study with a pretest-posttest control group design was conducted on 67 seventh-grade students randomly selected in Indonesia. Data collection for problem-solving ability utilized an essay test with 5 items, while for mathematical beliefs, a questionnaire of 24 statements with 4 answer choices was used. The results generalized that integrating Realistic Mathematics Education with Think Pair Share effectively enhances problem-solving ability and mathematical beliefs. The design of learning activities encouraged students to actively explore problems and interact to understand integer concepts. Developing various imaginable context based on Realistic Mathematics Education tenets is crucial to bridge the mathematics learning process.

Keywords: integer, mathematical beliefs, problem solving, realistic mathematics education, think pair share

1. Introduction

Mathematics is the study of numbers and their relationships, combinations, abstraction processes, and spatial configurations of operations between them (Adams & Hamm, 2010). Integers, one of the number sets, and their operations are the basis of more complex materials in mathematics that require counting and operations such as fractions, sets, and functions (Freudenthal, 2002). Students must master integer material before moving on to the next material, including real and rational numbers. However, there are challenges in studying integers, starting from understanding the concept of negative numbers, comprehending the properties of its operations, and applying integer concepts in solving problems (Bishop et al., 2011; Larsen, 2012; Sercenia et al., 2023).

Understanding the concept of integers and their operations in mathematics learning is crucial. Mistakes in understanding the concept of positive or negative numbers can affect the calculation process, leading to incorrect answers. Students who frequently make mistakes in determining answers can become frustrated and bored with mathematics learning (Pantziara & Philippou, 2015). One strategy in teaching numbers to help students understand the concept and make it enjoyable is to use problems with real-life contexts that are relatable and easy for students to imagine. This aligns with Freudenthal's view that mathematics is a problem-solving activity by implementing various concepts, principles, and procedures using different approaches such as axioms to enhance understanding (Gravemeijer & Terwel, 2000).

Incorporating daily problems into mathematics learning can encourage students to become familiar with problem-solving. This also supports the goals of Indonesian education, where problem-solving ability is one of the process standards in mathematics learning and a key aspect of numeracy literacy (Mendikbudristek, 2022; NCTM, 2000). The significance of learning problem-solving ability in elementary and secondary education is crucial because in the 21st century, innovative solutions are urgently needed for various problems arising from changes in environmental conditions, technological advancements, and human lifestyle culture.

Problem-solving ability is defined as a series of processes to find solutions to a problem through comprehending the context, developing strategies, implementing those strategies, and re-examining the solutions found (Polya, 1973). Problem-solving ability in mathematics learning can be used by individuals to acquire knowledge, skills, and understanding to meet the demands of unusual situations, where students must synthesize what they have learned and apply it to new and different situations (Krulik & Rudnick, 1988). Problem-solving ability is a mental process and the highest thinking skill in learning (Gagne et al., 2005; Layali & Masri, 2020). Problem-solving ability emphasizes not only the results found but also the process of finding solutions.

Students' problem-solving abilities are affected by many factors, one of which is mathematical beliefs (Pimta et al., 2009). Mathematical beliefs are a person's view of the world of mathematics or the perspective from which a person likes mathematics and mathematical tasks (Schoenfeld, 1989). Another notion of mathematical beliefs is students' feelings about mathematics, aspects of the class, or about themselves as mathematics learners that encourage them to complete mathematical tasks or problems (Kloosterman et al., 1996; Reyes, 1984). Therefore, in mathematics learning, teachers must be able to foster students' mathematical beliefs in addition to their problem-solving abilities and learning outcomes.

Strategies that can be practiced by teachers to foster mathematical beliefs and problem-solving ability include designing materials and classroom management is using innovative learning approaches and models. One of strategy in designing materials is to use the Realistic Mathematics Education (RME) approach. RME is an approach where learning starts from real situations or student experiences, emphasizing process skills rather than results (Zulkardi & Putri, 2010). The focus of RME emphasizes the use of situations that can be imagined by students (Van den Heuvel-Panhuizen & Drijvers, 2014). The use of contexts that can be imagined by students will help them interpret the information used to solve problems.

The RME principles include guided reinvention, didactical phenomenology, and a self-developed model where the mathematization process consists of horizontal and vertical components (Gravemeijer, 1994). The mathematization process involves generalizing a concept from the context horizontally and elaborating with other concepts vertically. Instruction in RME is also suitable for low attainer students with interventions given by teachers in the mathematization process from real context (Barnes, 2005). Providing RME in the long-term project has been proven to help students achieve positive results (Inci et al., 2023).

One of the advantages of RME is its flexibility to be applied to various materials such as plane geometry, transformation geometry, calculus, number operations, and equality, with an emphasis on its learning activities as didactical phenomenology (Fauzan, 1996; Gravemeijer & Doorman, 1999; Rawani et al., 2023; Theodora & Hidayat, 2018). Moreover, RME can be integrated with learning models such as problem-based learning and collaborative or cooperative learning (Ardiyani, 2018; Hakim & Setyaningrum, 2024; Pradipta et al., 2013; Uyen et al., 2021). One of the collaborative or cooperative learning models that has a similar character to RME is the Think Pair Share (TPS) setting because it provides experience in thinking independently and interacting with colleagues.

TPS is included in constructive learning because the learning activities are student-centered, where students are given more opportunities to think and share the results of their thinking by discussing with their friends (Arends, 2015). In TPS, students are divided into small groups with a maximum of 4 members (Slavin, 2017). Cooperative learning has the advantage of making students responsible for themselves and their groups as well as receiving feedback from each other (Kothiyal et al., 2013; Orlich et al., 2010). In addition, TPS has also been proven to foster interest, motivation, and learning achievement of students (Asria, 2019).

Based on previous research studies, the authors intend to integrate RME learning with TPS settings to enhance students' problem-solving ability and mathematical beliefs in integer material. In learning activities, students are given more time to try to solve imaginable problems and then discuss them as mental activities in the process of constructing knowledge from diverse perspectives (Fennema & Romberg, 1999). The integration of the RME approach with TPS is expected to be effective in terms of mathematical beliefs and problem-solving ability in integer learning. Furthermore, this study will analyze the effect of mathematical beliefs on problem-solving ability.

2. Method

This study utilized a quasi-experimental design with a pretest-posttest control group. The research procedure began with sample selection, pretest, treatment, and posttest. The research was conducted at a public junior high school in East Lampung Regency, Indonesia, chosen due to the school's education calendar aligning with the research timeline.

The population of the study comprised all 7th graders, totaling 234 students divided into 7 classes. Group samples were randomly selected, resulting in class A consisting of 34 students as the experimental group and class E with 33 students as the control group. The experimental group received a treatment of RME integrated into TPS settings, while the control group underwent TPS settings alone. The difference in treatment between the experimental and the control group is found in the student worksheets, activities, and instructions during learning.

The experiment was conducted over 3 sessions (3x80 minutes) covering the material: (1) introduction to integer numbers, (2) operations of integer numbers, and (3) factors of integer numbers with learning objectives outlined in Table 1. The total experiment time amounted to 4 hours. During learning activities, students were grouped into small groups consisting of 3-4 children each, with group members varying at each meeting.

Table 1. Learning objective

Subject matter	Learning objective
Introduction to integer number	Comprehending integer number
	Identifying integer number from a problem
Operation of integer number	Comprehending properties of integer number operation
	Solving problems related to integer number operation
Factor of integer number	Comprehending greatest common factor (*FPB*) and least common multiple (*KPK*) of integer number
	Solving problem related to *FPB* and *KPK*

The pretest instrument is equivalent to the posttest for the problem-solving ability test and the mathematical beliefs questionnaire. The problem-solving ability test uses 5 essay questions with material indicators according to Table 2, and problem-solving ability indicators refer to Polya's (1973) comprehending problems, planning strategy, implementing strategy, and drawing conclusions. The mathematical beliefs questionnaire consists of 24 statements with a Likert scale of 4 answer choices ranging from strongly disagree (1), disagree (2), agree (3), to strongly agree (4). The mathematical belief indicators refer to Sugiman (2009) consist of belief in mathematics as a subject, belief in self-mathematics ability, belief in the mathematics learning process, and belief in mathematics' usefulness.

Table 2. Competency Achievement Indicator

Indicator	Items Number
Identifying negative integers from a context	1
Sorting integer numbers	2
Solving problems related to integer number operation	3
Evaluating problems related to *FPB*	4
Evaluating problems related to *KPK*	5

The instruments developed by the authors were validated by two associate professors from the mathematics department of Yogyakarta State University. The validated instruments were revised according to the experts' advice before being tested. The reliability test of the instrument trials to 66 participants using Cronbach Alpha for problem-solving pretest ($\alpha = 0.72$) and posttest ($\alpha = 0.77$) as well as mathematical beliefs questionnaire ($\alpha = 0.96$) indicated high reliability.

Data analysis used descriptive and inferential statistical analysis. Descriptive statistical analysis consists of the mean and standard deviation. The maximum score for problem-solving ability is 100, while the minimum score is 0. The maximum score for mathematical beliefs is 96, while the minimum score is 24. Furthermore, to see the distribution of test results and respondent questionnaires, categorization is carried out referring to Azwar's (2016) psychometric scale.

Inferential statistical analysis involved a paired sample multivariate mean difference test to assess the effectiveness of the RME approach in the TPS setting by comparing the pretest and posttest results. An independent sample multivariate mean difference test was used to compare the effectiveness between the experimental and the control group. Meanwhile, a linear regression was conducted to analyze the effect of mathematical beliefs on problem-solving ability. Additionally, partial eta squared to determine the effect size of the experiment. The criterion for effectiveness is significant score increase in the posttest compared to the pretest.

3. Results

The results of the descriptive analysis aimed to explain the differences in the size of the data centralization of problem-solving ability and mathematical beliefs from the experimental group to the control group. The results of the descriptive analysis of problem-solving ability can be seen in Table 3.

Table 3. Descriptive statistics of students' problem-solving ability

Description	Experiment Group		Control Group	
	Pretest	**Posttest**	**Pretest**	**Posttest**
Mean	58.47	84.23	54.48	80.06
SD	15.08	8.38	14.83	6.77

The problem-solving ability average of the experimental group, both pretest and posttest, was higher than the control group (Table 3). In addition, the standard deviation of the problem-solving ability of the experimental group was also higher than the control group. This indicated that although the experimental group average was higher, the problem-solving ability of the control group was more evenly distributed. The analysis also found increment scores from the pretest to the posttest in the experimental and control groups. To see the details of the distribution of students' problem-solving abilities, a categorization was made in Table 4.

Table 4. Categorization of students' problem-solving ability

Interval	Category	Experiment				Control			
		Pretest		**Posttest**		**Pretest**		**Posttest**	
		n	**(%)**	***n***	**(%)**	***n***	**(%)**	***n***	**(%)**
$75 < X \leq 100$	Very high	4	11.7	30	88.3	3	9.4	25	75.7
$62.5 < X \leq 75$	High	12	35.3	4	11.7	9	27.2	8	24.3
$54.16 < X \leq 62.5$	Moderate	5	14.7	0	0	6	18.1	0	0
$45.84 < X \leq 54.16$	Low	5	14.7	0	0	6	18.1	0	0
$0 < X \leq 45.84$	Very low	8	24.6	0	0	9	27.2	0	0

Based on Table 4, the pretest indicated that many students had not reached the high category in the experimental group (54%) and control (63.4%). On the other hand, in the posttest results, most students in the experimental and control groups had reached the very high category. There were no students who had reached below high category. Furthermore, the results of the descriptive analysis of students' mathematical beliefs can be seen in Table 5.

Table 5. Descriptive statistics of students' mathematical beliefs

Description	**Experiment Group**		**Control Group**	
	Pretest	**Posttest**	**Pretest**	**Posttest**
Mean	62.62	80.65	63.76	72.30
SD	5.02	5.68	4.84	4.96

The average of the pretest mathematical beliefs of the control group students appeared slightly higher than the experimental group, but the standard deviation of the experimental group was narrowly higher than the control group. Meanwhile, the average and standard deviation of the experimental group posttest scores were higher than the control group. To see the details of the distribution of students' mathematical beliefs, a categorization was made in Table 6.

Table 6. Categorization of students' mathematical beliefs

Interval	**Category**	**Experiment**				**Control**			
		Pretest		**Posttest**		**Pretest**		**Posttest**	
		n	**(%)**	***n***	**(%)**	***n***	**(%)**	***n***	**(%)**
$78 < X \leq 96$	Very high	0	0	18	53.1	0	0	3	9.4
$66 < X \leq 78$	High	6	17.6	16	46.9	11	30	26	78.5
$54 < X \leq 66$	Moderate	26	76.6	0	0	20	60.6	4	12.1
$42 < X \leq 54$	Low	2	5.8	0	0	3	9.4	0	0
$24 < X \leq 42$	Very low	0	0	0	0	0	0	0	0

The distribution of students' mathematical confidence scores during the pretest mostly falls to the moderate level in the experimental and control groups, as can be seen in Table 6. Meanwhile, the posttest results showed an increase, where the experimental group mostly obtained very high scores, and the control group mostly obtained high scores. There were no students who had reached the low category or below.

To see the significance of the treatment effect, an inferential statistical analysis test was conducted. Before the inferential statistical analysis, the multivariate assumption tests of normality used *Henze-Zirkler* and homogeneity used *Box-M* had been met (Table 7). The results of the multivariate independent sample test for the pretest showed no difference between the experimental and the control group, $F_{(2,64)} = 1.272$, $p = 0.29$. This shows that the experimental and control groups have equivalent initial problem-solving abilities and mathematical beliefs.

Table 7. Normality and homogeneity test results

Test Indicator	**Normality**				**Homogeneity**	
	Pretest		**Posttest**		**Pretest**	**Posttest**
	Experiment	**Control**	**Experiment**	**Control**		
p-value	0.24	0.62	0.66	0.29	0.87	0.51

The following analysis is a multivariate paired sample test comparing pretest and posttest scores. The analysis results indicate a significant difference between pretest and posttest scores, $F_{(4,62)} = 31.047$, $p = 0.00$, $\eta^2 = 0.67$. This means that there is a significant increase in the posttest score compared to the pretest score on the variables of problem-solving ability and mathematical beliefs simultaneously. Consequently, there is a significant impact of learning in a collaborative setting of the TPS type, whether integrated with RME or not. The results of this analysis also support the distribution data in Table 4 and Table 6.

A subsequent analysis using linear regression revealed that mathematical beliefs have a significant effect on problem-solving ability, $F_{(1,65)} = 5.306$, $p = 0.02$. Mathematical beliefs have 7.5% effects on problem-solving ability ($R^2 = 0.075$), while the remainder is influenced by other factors. If mathematical beliefs increased by 1-point, problem-solving ability would increase by 0.319 points. This implies that problem-solving ability will be better if mathematical beliefs are better.

Furthermore, the multivariate independent sample test on the posttest score showed a significant difference between the experimental group and the control group, $F_{(2, 64)} = 21.034$, $p = 0.00$, $\eta^2 = 0.39$. This indicates that the problem-solving ability ($M = 84.23$, $SD = 8.38$) and mathematical belief ($M = 80.65$, $SD = 5.68$) of the experimental group were higher than the problem-solving ($M = 80.06$, $SD = 6.77$) and mathematical belief ($M = 72.30$, $SD = 4.96$) of the control group. Therefore, learning in a collaborative setting of the TPS model integrated with RME is superior to learning in a collaborative setting of the TPS model alone.

4. Discussion

The results of this study indicated that integrating RME with TPS settings is effective in improving students' problem-solving abilities and mathematical belief. This finding is in accord with previous study from Yuanita & Zakaria, (2016) and Afthina et al., (2017) which have indicated that the implementation of RME in TPS setting is not only effective promoting students' problem solving ability and mathematical belief, but also students' mathematical intelligence and representation. Furthermore, these results supports Husna et al. (2024) study, which explained that RME has been effective in enhancing cognitive achievements and problem-solving ability in various educational settings. Yuanita et al., (2018) added that learning using RME-based worksheets can support students in representing and modeling problems into mathematical models, enabling them to find solutions to problems.

A series of structured activities grounded in real-life contexts have been proven to lead students to attain better learning outcome (Marpaung et al., 2024). The use of problems in learning is not only an effort to drill but also a process of finding concepts. Learning activities with the RME approach encourage students to be actively involved in the problem-solving process (Ulandari et al., 2019). Nyoto et al. (2015) generalized that RME integrated with TPS was able to improve achievement in learning mathematics. This is supported by Hayati (2022) who stated that one of the most effective methods to increase learning effectiveness is to apply a collaborative approach such as TPS integrated with RME.

In the practice of RME learning in the TPS setting that is implemented, students are given the opportunity to independently understand (think) a problem related to the concept of numbers first. Students are also given the freedom to conduct observations and experiments, therefore, they can strengthen their skills in understanding problems as the first indicator in mathematics problem-solving ability (Sampsel, 2013). In addition, students are given the freedom to find their path to solving problems, hence, they can hone their problem-solving ability (Freudenthal, 2002). At this stage, the teacher can provide additional instructions tailored to help students in the mathematization process.

After comprehending the problem, students are asked not to immediately convey their answers but to exchange ideas in the next discussion activity. In the discussion activity (pair), to generalize the concepts of several problems as an application of the principle of didactical phenomenology, students are encouraged to convey the results of their understanding. Students who are involved in discussions during learning can learn from each other's problem-solving strategies and techniques, which is the second and third indicator in problem-solving ability (Ningsih, 2019). Furthermore, students who are allowed to express their ideas freely can also reduce their anxiety and build confidence in their mathematical abilities, thereby affecting their mathematical beliefs, especially in the second indicator, namely belief in self-mathematics ability (Farida et al., 2014).

In the pairing activity, students are given various development problems to apply the concepts that have been discovered as a reinvention process. Elaborating on concepts that have been discovered through problems can increase the completeness, accuracy, and variation of students' answers (Hidayat & Iksan, 2015). The real context used in the problems can also encourage students to explore and improve their perspectives on mathematics and its learning. Students who understand the usefulness of studying mathematics in their lives can be motivated to be involved in learning activities in order to increase mathematical beliefs, especially in the indicators of belief in mathematics' usefulness and learning process (Zakaria & Syamaun, 2017). Students with strong mathematical beliefs will have a strong desire and effort to study mathematics and complete assignments well, including solving difficult problems (Mason & Scrivani, 2004; Monica et al., 2019; Op't Eynde et al., 2002).

The final stage in learning is presenting the results of group discussions (share). Presentation activities can help students improve their ability to look back at the problem-solving process, which is the fourth indicator of problem-solving ability, by getting recommendations from their colleagues (Rifa'i & Lestari, 2018). Students who have different answers provide arguments to each other regarding the horizontal mathematization process, how to solve problems, and the calculation process. This provides a new perspective for students that problem-solving can be approached in various steps. Meanwhile, students who find solutions incorrectly can learn from other students. This can develop the mindset of students that from their mistakes, they can still learn new things. Students who are willing to learn from different perspectives and also the mistakes they make tend to unleash their potential and achieve better learning outcomes (Boaler, 2016; Francome & Hewitt, 2020).

The mathematization process through RME for grade VII students is very suitable because students are still in the early stages of formal operations, according to Piaget (Slavin, 2017). Students at that age are able to do abstraction but with the help of concrete objects in worksheets and scaffolding from teachers or more proficient colleagues in group discussions (Langford, 2005). Providing the right scaffolding can help students so that learning is more effective (Manaf et al., 2024). An example of a problem in learning with RME can be seen in Figure 1.

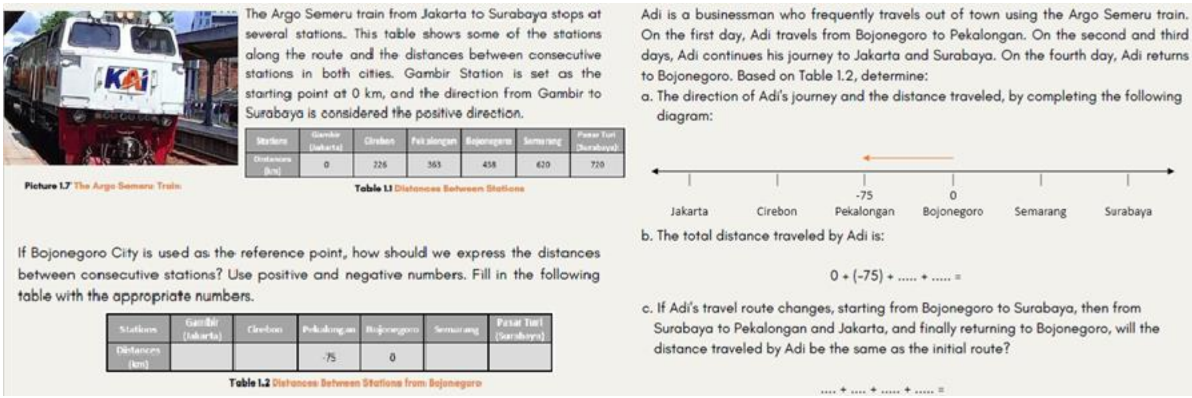

Figure 1. Matematization activity in students' worksheets

In Figure 1, students are presented with a problem involving the addition and subtraction of integers within the imaginable context of distances to each station with the origin point from the city of Jakarta. The students are then asked to independently determine different distances, namely consecutive distances, if the departure point is changed from the city of Bojonegoro based on the information table. This stage demonstrates the horizontal mathematization process where students grasp the concept of positive and negative number operations from a real context. In the following problem regarding the distance of Mr. Adi's trip, students are asked to work in groups to solve problems related to the elaboration of the concept of positive and negative number operations as a vertical mathematization process.

Questions in point c, regarding Mr. Adi's travel distance (Figure 1), assess the students' ability to evaluate a problem. Evaluating is not only a high-level thinking skill but also an indicator of problem-solving ability (Anderson & Krathwohl, 2001). Through frequent problem-solving exercises, students can improve their problem-solving ability. Problem-solving ability has a significant impact on students' mathematics learning achievement, where students with strong problem-solving ability typically achieved better results in mathematics (Agustina et al., 2024).

However, teachers must consider specific aspects when developing a problem. Teachers need to adjust the problem to the age and socio-cultural background of the students (Mahdiansyah & Rahmawati, 2014). The problems developed should also consider aspects such as the gender of the students so that they are easier to understand (Sulistyawati & Radite, 2024). In addition, teachers can also create problems that target higher order thinking skills to elaborate on each concept learned. Thus, problems can make learning meaningful and effective in achieving various expected educational goals.

5. Conclusion

This study concluded that Think Pair Share implementation effectively improves problem-solving ability and mathematical beliefs in integer learning. Integrating Realistic Mathematics Education approach to Think Pair Share learning model is more effective than using Think Pair Share alone. Developing problems based on Realistic Mathematics Education with various real contexts that students can imagine is necessary for different learning materials. This study has limitations as it did not delve into the perceptions and obstacles experienced by students in Realistic Mathematics Education learning integrated with Think Pair Share. This study also did not consider the level of students' prior knowledge. Therefore, further research could analyze the relationship or the effect of students' prior knowledge on learning achievements in the Realistic Mathematics Education learning setting integrated with Think Pair Share.

References

1. Adams, D., & Hamm, M. (2010). *Demystify math, science, and technology: creativity, innovation, and problem-solving*. Rowman and Littlefield Education.
2. Afthina, H., Mardiyana, & Pramudya, I. (2017). Think pair share using realistic mathematics education approach in geometry learning. *Journal of Physics: Conference Series*, *895*(1). https://doi.org/10.1088/1742-6596/895/1/012025
3. Agustina, T. R., Kismiantini, & Radite, R. (2024). The effect of mathematical problem-solving ability and mathematics self-concept on learning achievement. *Jurnal Riset Pendidikan Matematika*, *11*(1), 27–40. https://doi.org/10.21831/jrpm.v11i1.73046
4. Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Addison Wesley Longman.
5. Ardiyani, S. M. (2018). Realistic mathematics education in cooperative learning viewed from learning activity. *Journal on Mathematics Education*, *9*(2), 301–310. https://eric.ed.gov/?id=EJ1194281
6. Arends, R. I. (2015). *Learning to teach* (10th ed.). McGraw-Hill Education.
7. Asria, V. Z. (2019). Improving concept comprehension ability in mathematics by using mathematical model: Think-pair-share approach. *Journal of Physics: Conference Series*, *1402*(7). https://doi.org/10.1088/1742-6596/1402/7/077083
8. Azwar, S. (2016). *Penyusunan skala psikologi*. Pustaka Pelajar.
9. Barnes, H. (2005). The theory of realistic mathematics education as a theoretical framework for teaching low attainers in mathematics. *Pythagoras*, *61*, 42–57. https://doi.org/10.10520/EJC20851
10. Bishop, J., Lamb, L., Philipp, R., Schappelle, B., & Whitacre, I. (2011). First graders outwit a famous mathematician. *Teaching Children Mathematics*, *17*, 350–358. https://doi.org/10.2307/41199692
11. Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. Jossey-Bass.
12. Farida, F., Hartatiana, H., & Joemsittiprasert, W. (2014). The use of realistic mathematics education (RME) in improving mathematical analogical ability and habits of mind. *Al-Jabar : Jurnal Pendidikan Matematika*, *10*(2), 175–186. https://doi.org/10.24042/ajpm.v10i2.3540
13. Fauzan, A. (1996). *Applying Realistic Mathematics Education (RME) in teaching geometry in Indonesian primary schools* [University of Twente]. https://research.utwente.nl/en/publications/applying-realistic-mathematics-education-rme-in-teaching-geometry
14. Fennema, E., & Romberg, T. A. (1999). *Mathematics classrooms that promote understanding*.

Lawrence Erlbaum Associates, Inc., Publishers.
15. Francome, T., & Hewitt, D. (2020). My math lessons are all about learning from your mistakes": how mixed-attainment mathematics grouping affects the way students experience mathematics. *Educational Review*, *72*(4), 475–494. https://doi.org/10.1080/00131911.2018.1513908
16. Freudenthal, H. (2002). *Didactical phenomenology on mathematical structures*. Kluwer Academic Publisher.
17. Gagne, R. M., Wager, W. W., Golas, K. C., Keller, J. M., & Russell, J. D. (2005). *Principles of instructional design*. Wiley Online Library.
18. Gravemeijer, K. P. E. (1994). *Developing realistic mathematics education* [CD-ß Press/Freudenthal Institute]. https://research.tue.nl/en/publications/developing-realistic-mathematics-education
19. Gravemeijer, K. P. E., & Doorman, M. (1999). Context problems in realistic mathematics education: A calculus course as an example. *Educational Studies in Mathematics*, *39*(1), 111–129. https://doi.org/10.1023/A:1003749919816
20. Gravemeijer, K. P. E., & Terwel, J. (2000). Hans Freudenthal a mathematician on didactics and curriculum theory. *Journal of Curriculum Studies*, *32*(6), 777–796. https://doi.org/10.1080/00220270050167170
21. Hakim, T. A., & Setyaningrum, W. (2024). Realistic mathematics education combined with guided discovery for improving middle school students' statistical literacy. *Journal of Honai Math*, *7*(2), 233–246. https://journalfkipunipa.org/index.php/jhm/article/view/564
22. Hayati, N. (2022). Implementation of the think-pair-share learning model based on RME in an effort to increase achievement for Class VII D SMPN 2 Kumai. *Anterior Jurnal*, *22*(Special-1), 101–104. https://doi.org/10.33084/anterior.v22iSpecial-1.3224
23. Hidayat, R., & Iksan, Z. H. (2015). The Effect of Realistic Mathematic Education on Students' Conceptual Understanding of Linear Progamming. *Creative Education*, *06*(22), 2438–2445. https://doi.org/10.4236/ce.2015.622251
24. Husna, A., Mailizar, M., Elizar, E., Maidiyah, E., Suryawati, & Lacia, M. R. (2024). Students' ability in solving TIMSS problems through realistic mathematics education. *The 2nd Annual International Conference on Mathematics, Science and Technology Education (AICMSTE 2023)*. https://doi.org/10.2991/978-2-38476-216-3_2
25. Inci, A. M., Peker, B., & Kucukgencay, N. (2023). Realistic mathematics education. In O. Cardak & S. A. Kiray (Eds.), *Current Studies in Educational Disciplines* (pp. 66–83). ISRES Publishing.
26. Kloosterman, P., Raymond, A. M., & Emenaker, C. (1996). Students' beliefs about mathematics: A three-year study. *The Elementary School Journal*, *97*(1), 39–56. https://doi.org/10.1086/461848
27. Kothiyal, A., Majumdar, R., Murthy, S., & Iyer, S. (2013). *Effect of think-pair-share in a large CS1 class*. *August*, 137–144. https://doi.org/10.1145/2493394.2493408
28. Krulik, S., & Rudnick, J. A. (1988). *Problem solving: A handbook for elementary school teachers* (1st ed.). Allyn & Bacon.
29. Langford, P. E. (2005). *Vigotsky's developmental and educational psychology*. Psychology Press.
30. Larsen, J. (2012). Epistemological obstacles of negative numbers. *Vector: The Official Journal of the BC Association of Mathematics Teachers*, *53*, 56–60. https://www.researchgate.net/publication/274310485_Epistemological_Obstacles_of_Negative_Numbers
31. Layali, N. K., & Masri, M. (2020). Kemampuan pemecahan masalah matematis melalui model treffinger di SMA. *Jurnal Pendidikan Matematika Raflesia*, *5*(2), 137–144. https://ejournal.unib.ac.id/jpmr/article/view/11448
32. Mahdiansyah, M., & Rahmawati, R. (2014). Literasi matematika siswa pendidikan menengah: Analisis menggunakan desain tes internasional dengan konteks Indonesia. *Jurnal Pendidikan Dan Kebudayaan*, *20*(4), 452–469. https://doi.org/10.24832/jpnk.v20i4.158
33. Manaf, L. I. A., Wutsqa, D. U., & Radite, R. (2024). Effectiveness of scaffolding technique in scientific learning model on students mathematics critical thinking skills and self-regulated learning. *Al-Islah: Jurnal Pendidikan*, *16*(4), 5831–5843. https://doi.org/10.35445/alishlah.v16i4.5862
34. Marpaung, I., Arnita, A., & Fauzi, K. M. A. (2024). Development of student worksheets based on a realistic mathematics learning approach to improve problem solving ability and self-efficacy. *The 5th*

International Conference on Science and Technology Applications, ICoSTA 2023. https://doi.org/10.4108/eai.2-11-2023.2343263
35. Mason, L., & Scrivani, L. (2004). Enhancing students' mathematical beliefs: an intervention study. *Learning and Instruction*, *14*(2), 153–176. https://doi.org/10.1016/j.learninstruc.2004.01.002
36. Mendikbudristek. (2022). *Permendikbudristek Nomor 05 tentang Standar Kompetensi Lulusan Pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah*. Biro Hukum Kemdikbudristek.
37. Monica, H., Kesumawati, N., & Septiati, E. (2019). Pengaruh model problem based learning terhadap kemampuan pemecahan masalah matematis dan keyakinan matematis siswa. *Mapan: Jurnal Matematika Dan Pembelajaran*, *7*(1), 155–166. https://doi.org/10.24252/mapan.2019v7n1a12
38. NCTM. (2000). *Principles and standard for school mathematcis*. The National Council of Teacher of Mathematics, Inc.
39. Ningsih, Y. (2019). The use of cooperative learning models think pair share in mathematics learning. *Journal of Physics: Conference Series*, *1387*(1). https://doi.org/10.1088/1742-6596/1387/1/012144
40. Nyoto, N., Usodo, B., & Riyadi, R. (2015). Eksperimentasi model pembelajaran kooperatif tipe think pair share (TPS) dengan pendekatan realistic mathematics education (RME) ditinjau dari gaya belajar siswa kelas VIII SMP/MTS di Kabupaten Sragen. *Jurnal Pembelajaran Matematika*, *3*(5), 553–563. https://jurnal.uns.ac.id/jpm/article/view/10704
41. Op't Eynde, P., De Corte, E., & Verschaffel, L. (2002). Framing students' mathematics-related beliefs: A quest for conceptual clarity and a comprehensive categorization. In *Beliefs: A hidden variable in mathematics education?* (pp. 13–37). Springer Netherlands. https://doi.org/10.1007/0-306-47958-3
42. Orlich, D. C., Harder, R. J., Callahan, R. C., Trevisan, M. S. T., & Brown, A. H. (2010). *Teaching strategies: A guide to effective instruction*. Cengage Learning.
43. Pantziara, M., & Philippou, G. N. (2015). Students' motivation in the mathematics classroom. Revealing causes and consequences. *International Journal of Science and Mathematics Education*, *13*, 385–411. https://doi.org/10.1007/s10763-013-9502-0
44. Pimta, S., Tayruakham, S., & Nuangchale, P. (2009). Factors influencing mathematic problem-solving ability of sixth grade students. *Journal of Social Sciences*, *5*(4), 381–385. https://doi.org/10.3844/jssp.2009.381.385
45. Polya, G. (1973). *How to solve it* (2nd ed.). Princeton University Press. https://doi.org/10.2307/j.ctvc773pk.6
46. Pradipta, M. A., Suadnyana, I. N., & Darsana, I. W. (2013). Pengaruh model pembelajaran problem based learning melalui pendekatan realistic mathematics education terhadap hasil belajar matematika kelas iv sekolah dasar. *MIMBAR PGSD*, *1*(1). https://ejournal.undiksha.ac.id/index.php/JJPGSD/article/view/1208
47. Rawani, D., Putri, R. I. I., Zulkardi, & Susanti, E. (2023). RME-based local instructional theory for translation and reflection using of South Sumatra dance context. *Journal on Mathematics Education*, *14*(3), 545–562. https://doi.org/10.22342/jme.v14i3.pp545-562
48. Reyes, L. H. (1984). Affective variables and mathematics education. *The Elementary School Journal*, *84*(5), 558–581. https://doi.org/10.1086/461384
49. Rifa'i, A., & Lestari, H. P. (2018). The effect of Think Pair Share (TPS) using scientific approach on students' self-confidence and mathematical problem-solving. *Journal of Physics: Conference Series*, *983*(1). https://doi.org/10.1088/1742-6596/983/1/012084
50. Sampsel, A. (2013). Finding the effects of think-pair-share on student confidence and participation. *Honor Project*, *28*, 1–19. https://scholarworks.bgsu.edu/honorsprojects/28
51. Schoenfeld, A. H. (1989). Explorations of students' mathematical beliefs and behavior. *Journal for Research in Mathematics Education*, *20*(4), 338. https://doi.org/10.2307/749440
52. Sercenia, J. C., Ibañez, E. D., & Pentang, J. T. (2023). Thinking beyond thinking: Junior high school students' metacognitive awareness and conceptual understanding of integers. *Mathematics Teaching-Research Journal*, *15*(1), 4–24. https://eric.ed.gov/?id=EJ1391473
53. Slavin, R. E. (2017). *Educational psychology* (12th ed., Vol. 25, Issue 12). New York: Pearson.
54. Sugiman. (2009). Aspek keyakinan matematik siswa dalam pendidikan matematika. *Pendidikan*

Matematika (Universitas Yogyakarta), 1–12.
55. Sulistyawati, E., & Radite, R. (2024). Mathematical communication of preservice mathematics teachers in solving gender-biased higher-order thinking skills problems. *Indonesian Journal of Science and Mathematics Education*, *7*(2), 234–251. https://doi.org/10.24042/ijsme.v7i2.19636
56. Theodora, F. R. N., & Hidayat, D. (2018). The use of realistic mathematics education in teaching the concept of equality. *Journal of Holistic Mathematics Education*, *1*(2), 104–113. https://doi.org/10.19166/johme.v1i2.913
57. Ulandari, L., Amry, Z., & Saragih, S. (2019). Development of learning materials based on realistic mathematics education approach to improve students' mathematical problem solving ability and self-efficacy. *International Electronic Journal of Mathematics Education*, *14*(2), 375–383. https://doi.org/10.29333/iejme/5721
58. Uyen, B. P., Tong, D. H., Loc, N. P., & Thanh, L. N. P. (2021). The effectiveness of applying realistic mathematics education approach in teaching statistics in grade 7 to students' mathematical skills. *Journal of Education and E-Learning Research*, *8*(2), 185–197. https://doi.org/10.20448/JOURNAL.509.2021.82.185.197
59. Van den Heuvel-Panhuizen, M., & Drijvers, P. (2014). Realistic mathematics education. In S. Lerman (Ed.), *Encyclopedia of mathematics education* (pp. 521–525). Springer Netherlands. https://doi.org/10.1007/978-94-007-4978-8_170
60. Yuanita, P., & Zakaria, E. (2016). The effect of realistic mathematics education (RME) implementation to mathematics belief, mathematics representative and mathematics problem solving. *Advanced Science Letters*, *22*(8), 1989–1992. https://doi.org/10.1166/asl.2016.7754
61. Yuanita, P., Zulnaidi, H., & Zakaria, E. (2018). The effectiveness of realistic mathematics education approach: The role of mathematical representation as mediator between mathematical belief and problem solving. *PloS One*, *13*(9), e0204847. https://doi.org/10.1371/journal.pone.0204847
62. Zakaria, E., & Syamaun, M. (2017). The effect of realistic mathematics education approach on students' achievement and attitudes towards mathematics. *Mathematics Education Trends and Research*, *1*(1), 32–40. http://www.ispacs.com/journals/metr/2017/metr-00093/
63. Zulkardi, Z., & Putri, R. I. I. (2010). Pengembangan blog support untuk membantu siswa dan guru matematika Indonesia belajar pendidikan matematika realistic Indonesia (PMRI). *Jurnal Inovasi Perekayasa Pendidikan (JIPP)*, *2*(1), 1–24. https://repositori.kemdikbud.go.id/203/